

CAREX CYRTOSTACHYA (CYPERACEAE), A NEW SPECIES OF SEDGE ENDEMIC TO THE SIERRA NEVADA OF CALIFORNIA

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ABSTRACT

Carex cyrtostachya is described as a narrow endemic from the western slope of the northern Sierra Nevada of California. Details about its taxonomy, distribution, and ecology are included. *Carex cyrtostachya* is distinguished from *Carex mendocinensis* by its more flexuous distal lateral spikes with more widely spaced perigynia, longer and paler pistillate scales, and longer staminate scale awns. A key and illustrations are provided. Lectotypes are designated for *Carex cinnamomea* and *Carex mendocinensis*.

RESUMEN

Se describe *Carex cyrtostachya* como endemismo de la vertiente norte de la Sierra Nevada de California. Se incluyen detalles de su taxonomía, distribución, y ecología. *Carex cyrtostachya* se distingue de *Carex mendocinensis* por sus espigas laterales distales más flexuosas con utrículos más espaciados, escamas pistilares más largas y más pálidas, y aristas de las escamas estaminales más largas. Se aporta una clave e ilustraciones. Se designan lectotipos para *Carex cinnamomea* y *Carex mendocinensis*.

KEY WORDS: California, *Carex*, *Carex* section *Hymenochlaenae*, Cyperaceae, narrow endemic, Sierra Nevada

Several workers in the flora of the northern Sierra Nevada of California have been puzzled by a sedge resembling *Carex mendocinensis* Olney ex W. Boott, but which differs from it on the basis of inflorescence features and is disjunct from the coastal and coast range habitats of that species (Janeway 1992; Oswald & Ahart 1994; Oswald 2002; Clifton 2003, 2005; Taylor 2010). After studying the Sierran populations, we describe them here as a new species. It was first collected in 1968 by G. Ledyard Stebbins.

Carex cyrtostachya Janeway & Zika, sp. nov. (Figs. 1, 2A, 3A-B, 4A-G, 5) TYPE: U.S.A. CALIFORNIA. Butte Co.: Forest Road 20N03 (Mooreville Ridge Road), 2 air mi SE of Sugar Pine Point, Pinkard Creek drainage, 1075 m, 5 Aug 2011, Zika 25715 & Wilson, Ahart, Janeway (HOLOTYPE: WTU; ISOTYPES: BRU, CAS, CHSC, DAV, GH, JEPS, MICH, NY, OSC, RSA).

Carex cyrtostachya differs from *Carex mendocinensis* in its more flexuous distal lateral spikes with more widely spaced perigynia, longer and paler pistillate scales, and longer staminate scale awns.

Plants caespitose, with short rhizomes; roots brown, not densely felted with root hairs. Fertile culms (stems) 20–132 cm long, 0.4–2.3 mm wide, trigonous, smooth on the angles; basal sheaths scale-like, bladeless, with pale veins, scabrous-ciliate, dark purple, grading above into red-purple, red-brown, and green sheaths, the upper of these bearing blades. **Leaves** (2–)3–5, mostly on lower half of culm; sheaths 6–80(–142) mm long, tightly clasping culm, glabrous to scabrous, green, the sheath faces (opposite blade) green to whitish, often

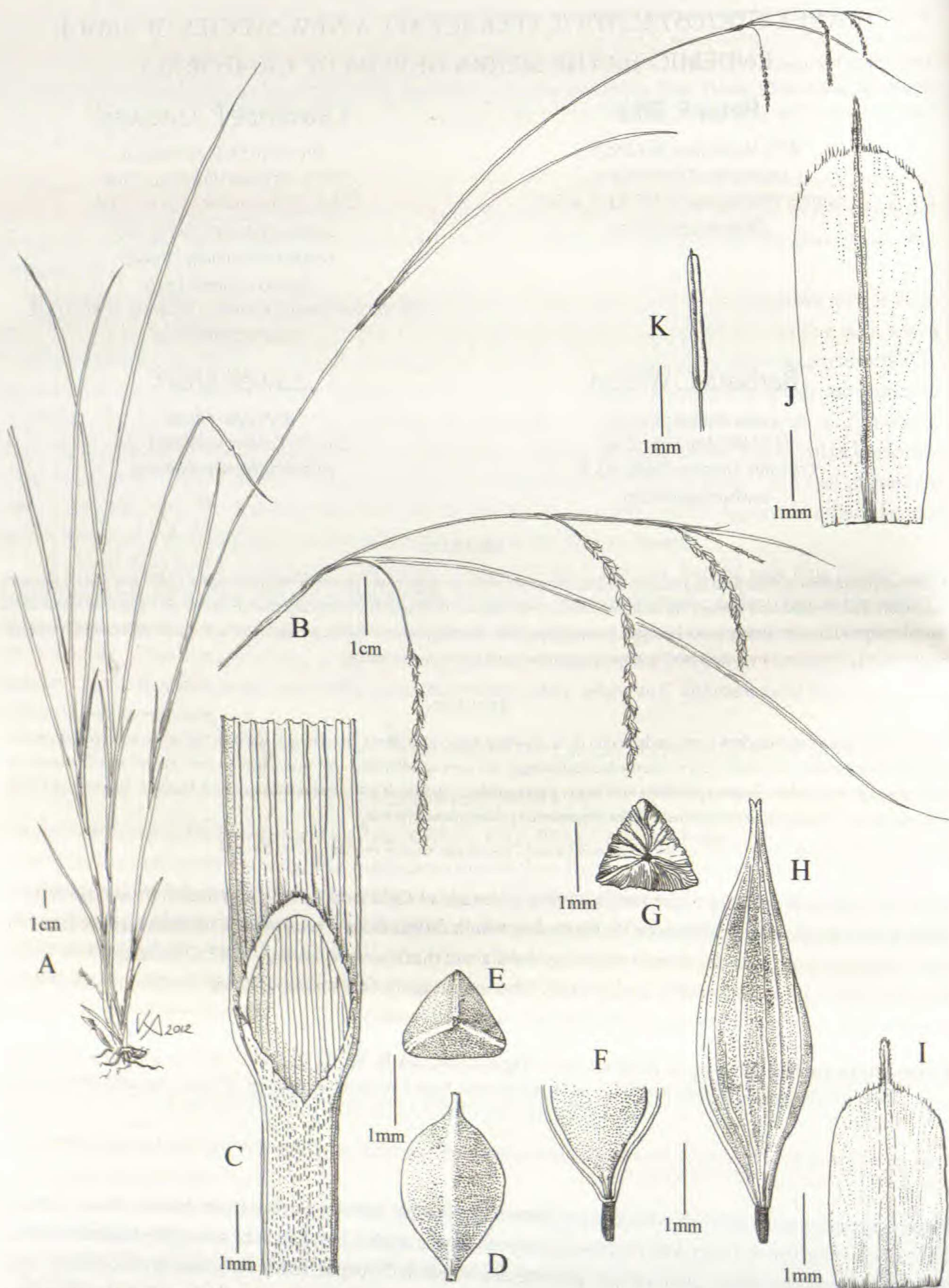


FIG. 1. *Carex cyrtostachya* (Zika 25715, except C, Zika 25712). A. Habit. B. Inflorescence showing drooping pistillate spikes and lax culm. C. Sheath, blade, and ligule, with culm removed. D. Achene, side view. E. Achene, top view. F. Perigynium partially dissected to show stipitate base of achene, above scale. G. Perigynium top view, triangular in cross-section. H. Perigynium side view, showing darkened stipitate base. I. Pistillate scale. J. Staminate scale. K. Stamen, showing bristle tipped anther.

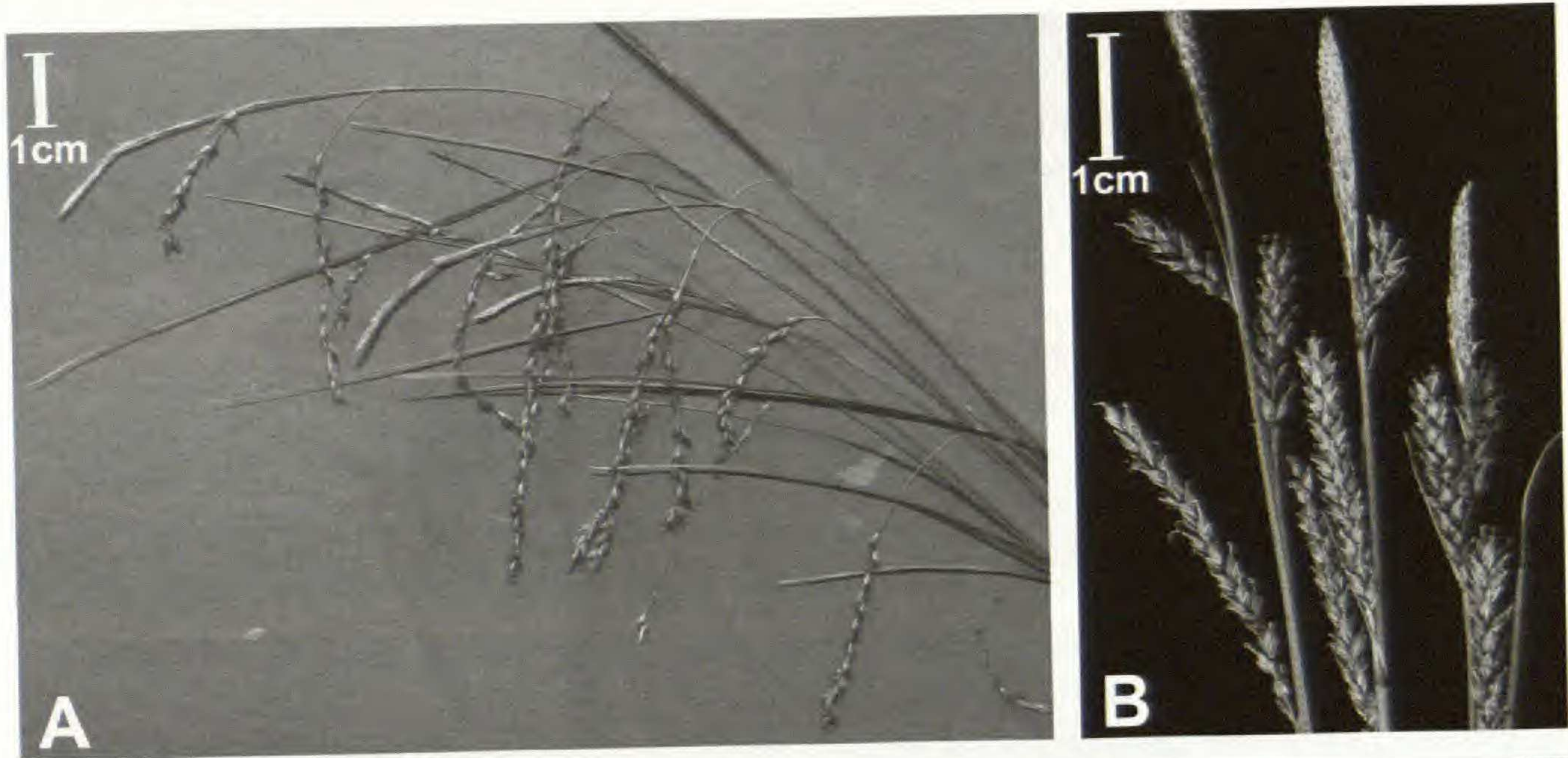


FIG. 2. Comparison of inflorescences, live plants. **A.** *Carex cyrtostachya*, showing drooping distal pistillate spikes on lax peduncles (Zika 25715 et al.). **B.** *Carex mendocinensis*, showing erect distal pistillate spikes on erect peduncles (Zika 13156).

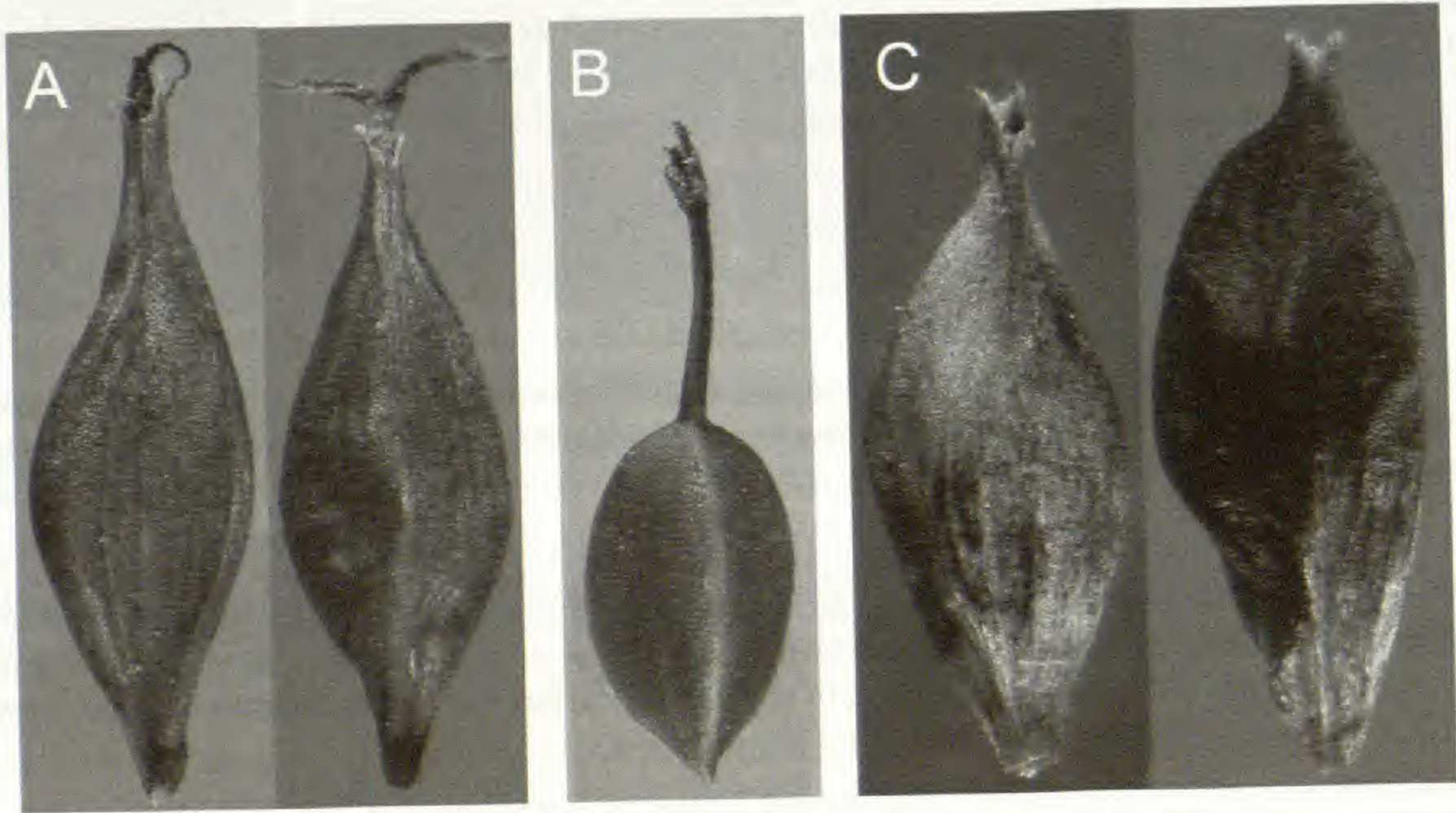


FIG. 3. Comparison of dried perigynia. **A.** *Carex cyrtostachya* perigynia, green to light brown (Zika 25713 et al.). **B.** *Carex cyrtostachya* achene (Zika 25713 et al.). **C.** *Carex mendocinensis* perigynia, green to light brown with dark purple markings (Zika 25485).

dotted with red or purple, glabrous or scabrous, the apex (mouth) U- or V-shaped, ciliate, fragile; ligules 1.1–12.6 mm long, longer than wide, apex acute or acuminate, occasionally rounded, ciliate; blades 0.5–42 cm long, (1.3–)1.5–4.5(–6) mm wide, flat, V- or W-shaped in cross-section, occasionally strongly scabrous on ad-axial surface near ligule, otherwise smooth, with 1–3 pale prominent abaxial veins, margins scabrous distally. Vegetative shoots similar to fertile shoots; pseudoculms (overlapping leaf sheaths of vegetative shoots, see Reznicek 1986) 4–6 cm tall, with 3–6 leaves, the larger basal leaves 2.5–5.7 mm wide. Proximal inflorescence bracts with sheaths (2.5–)6–42 mm long, the blades shorter than to exceeding inflorescence, 5.5–25.5 cm long, 0.9–2.5 mm wide, glabrous or slightly ciliate, the distal bracts much reduced. **Inflorescences** 5–47 cm long, the lateral spikes pistillate, the terminal spike staminate; proximal lateral spikes on peduncles 17–171 mm

long, the portion exerted from the sheath 10–114 mm long (rarely the proximal spike branching once from the basal pistillate scale, *Janeway 9080 CHSC, Rubtsoff 7088 & Howell CAS*); lateral spikes solitary at the nodes, arching, often drooping at maturity on flexible, smooth or slightly scabrous peduncles, the two proximal spikes separated by 2–28 cm, the distal spikes overlapping, on peduncles 5–25 mm long, rarely sessile; terminal spike erect on peduncle 5–26 mm long. **Spikes** 3–6, the lateral spikes pistillate (very rarely androgynous), cylindrical, 18–93 mm long, 2–5.7 mm thick, with (10–)14–29 perigynia attached 0.7–3.5(–6) mm apart, the terminal spike staminate, 10–64 mm long, 1.1–2.3 mm thick, rarely gynecandrous (*Rubtsoff 7088 & Howell CAS*) and the lower half staminate. **Pistillate scales** usually shorter than mature perigynia, obovate to oblong-obovate, (2.2–)3–4.8(–6.8) mm long including glabrous or ciliate awn, acute, rounded or notched at apex (apart from awn), glabrous with ciliate or erose margins distally, white-hyaline or faintly marked with red-brown, uncommonly red-spotted; awn (0–)0.5–2.2(–3.1) mm long; midrib broad, green, aging brown, with 1–3 veins, rarely with sparse bristles distally. **Staminate scales** densely overlapping, clasping at base, oblanceolate to oblong-ob lanceolate, 4–6.9(–8) mm long, acute, rounded, or notched at apex, hyaline with green midvein, glabrous, the proximal scales with prominent awn 0.5–3(–5) mm long. **Anthers** 3, 1.8–3 mm long, slightly ciliate at apex (40 \times). **Perigynia** erect-ascending or appressed when mature, (3.2–)3.8–5.8 mm long, 1.1–1.8 mm wide, bases gradually narrowed to darker stipes 0.3–0.6 mm long; body \pm flattened-trigonous, \pm symmetrical in top view, 2-ribbed and finely 12–15-veined, green, aging to brown, occasionally with inconspicuous red or purple dots, membranous, glabrous, gradually tapered to beak; beak (0.5–)0.7–1.4 mm long (measured from inflection point); apical teeth obscure, 0.2–0.6 mm long, often ciliate on or between them. **Achenes** (nutlets) 1.9–2.7 mm long (not including style remnant or stipe), 1.1–1.6 mm wide, trigonous, stipitate, the distance from the base of the achene body to the base of the perigynium (0.5–)0.7–1.2 mm, achene sides \pm flat to slightly concave, obovate to elliptic, \pm loosely enclosed by perigynium, pale brown, papillose (40 \times). **Styles** withering but \pm straight and persisting in the mature perigynia, where easily broken; stigmas 3.

Achene surface micromorphology.—We gathered ripe achene specimens in 2011 from two accessions of *Carex cyrtostachya* and three accessions of *C. mendocinensis*. Following Waterway (1990a), we removed the waxy cuticle and the outer periclinal walls of the epidermal cells with a 6-hour treatment in deionized water in a Branson Model 1210 Branson cleaner, exposing the papillae (formed by conical silica bodies) on the inner periclinal walls of the epidermal cells. Achenes were next rinsed three times in deionized water, air dried overnight in a desiccator, then mounted and sputter coated with gold for three minutes (10 mA, at 65 mTorr) with a Technics Hummer V. Digital scans were captured with a JEOL JSM-840A SEM. Because the shape and number of papillae varied the most near the angles of the achenes, our scans were all from the central portion of the achene faces.

Although we found considerable variation in the achene surfaces of *Carex cyrtostachya* and *C. mendocinensis* (Fig. 4), considerable differences in surface micromorphology between the two species were apparent. *Carex mendocinensis* tends to have many papillae (up to six) per cell (Fig. 4J, L, M). The papillae can cover a large portion of the supporting cell platform (Fig. 4M, N). The gaps between cells can be wide and intricately buttressed (Fig. 4M, N). In contrast *C. cyrtostachya* had one (or rarely two) papillae per cell (Fig. 4D, E), the papillae often occupied a smaller percentage of the supporting platform (Fig. 4C, G), and the gaps between cells tended to be narrow and without ornament (Fig. 4G). However, our sample was small, and some achene surfaces were similar for the two species (Fig. 4C, E vs. J, K). *Carex cyrtostachya* achene surfaces also resembled those of *C. hirtissima* W. Boott (Waterway 1990a, Fig. 8).

Phenology and ecology.—*Carex cyrtostachya* fruits from May through August, depending on elevation and exposure. It ranges from 600–1350 m elevation. According to herbarium labels, the colonies are found over argillite, granodiorite, and (rarely) peridotite bedrock. The sites vary from full sun to shade, in wet meadows, marshes, seasonally wet outcrops, seeps, swales, and riparian margins with saturated soil, as well as floodplain terraces on more mesic soils.

Carex cyrtostachya commonly grows in the shade of woody species such as *Acer macrophyllum* Pursh, *Alnus rhombifolia* Nutt., *Arbutus menziesii* Pursh, *Calocedrus decurrens* (Torr.) Florin, *Cornus nuttallii* Audubon ex

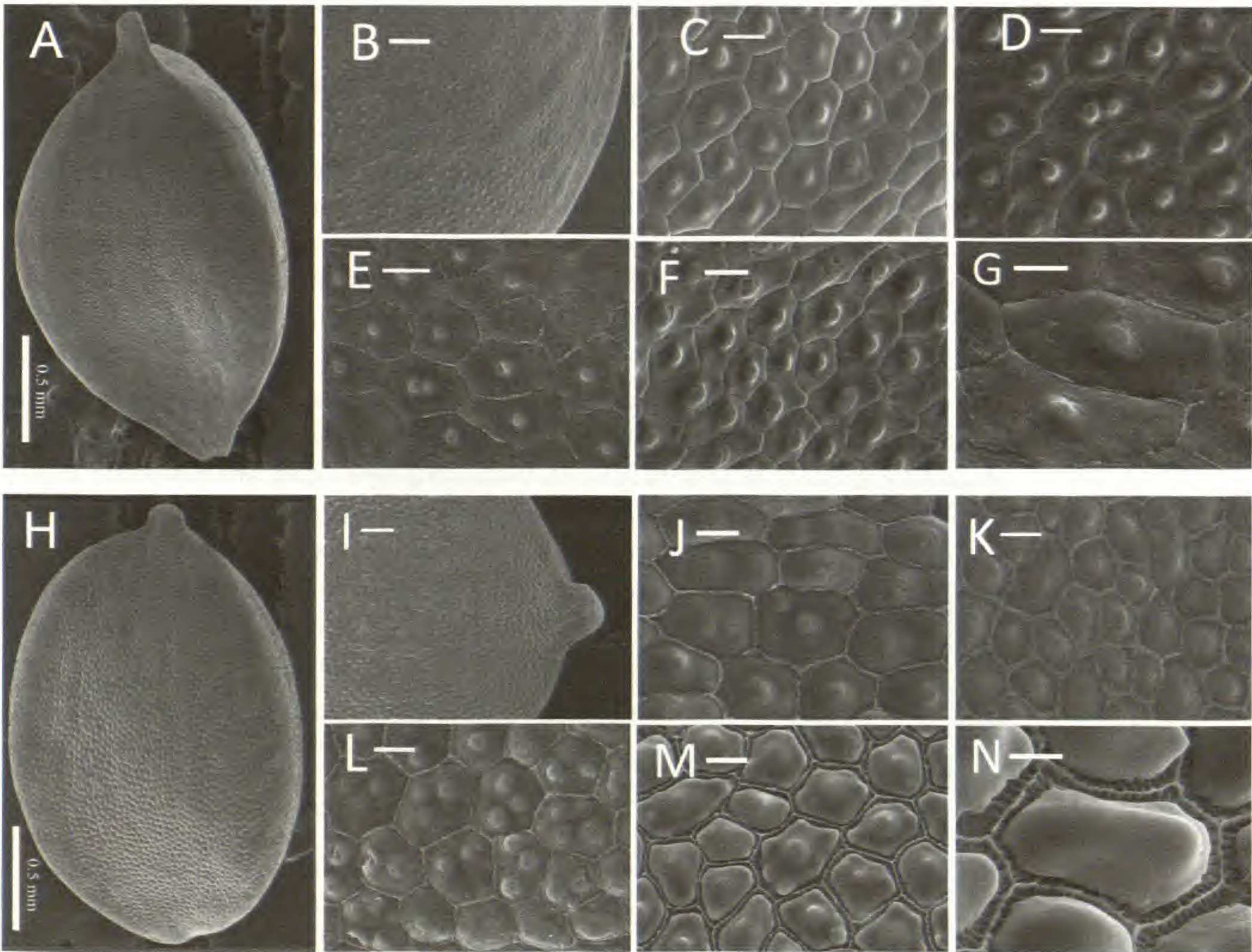


FIG. 4. SEM images of achene surfaces of *Carex cyrtostachya* and *C. mendocinensis*. **A–G:** *Carex cyrtostachya* (all Yuba Co., California, *Zika* 25718; except **B–C**, Butte Co., California, *Zika* 25715). **A)** Achene shape. **B)** Papillose achene surface; scale = 100 μm. **C–F)** Variation in cell surfaces, mostly one papilla per cell, occasionally two; scale = 20 μm. **G)** Detail of cell surfaces, narrow gaps between cells, broad platforms surrounding relatively small central and round-topped solitary papillae; scale = 10 μm. **H–N:** *Carex mendocinensis*; **H–J, L**, Josephine Co., Oregon, *Zika* 25485; **K**, Josephine Co., Oregon, *Zika* 25488; **M–N**, Humboldt Co., California, *Zika* 25496. **H)** Achene shape. **I)** Papillose achene surface; scale = 100 μm. **J–M)** Variation in cell surfaces, one to five papillae per cell; scale = 20 μm. **J)** Broad platforms surrounding relatively small central and round-topped solitary papillae. **M)** Narrow or obscure platforms surrounding large and coalesced central papillae. **N)** Detail of cell surfaces, broad gaps between cells, steep-sloping and relatively large acute-topped papillae; scale = 10 μm.

Torr. & A. Gray, *Corylus cornuta* Marshall, *Lithocarpus densiflorus* (Hook. & Arn.) Rehder, *Pinus contorta* Douglas ex Loudon, *P. lambertiana* Douglas, *P. ponderosa* Douglas ex Lawson & C. Lawson, *P. sabiniana* Douglas ex D. Don, *Pseudotsuga menziesii* (Mirb.) Franco, *Quercus durata* Jeps., *Rhododendron occidentale* (Torr. & A. Gray) A. Gray, *Rubus armeniacus* Focke, *R. laciniatus* Willd., and *R. leucodermis* Douglas ex Torr. & A. Gray. Herbaceous associates are diverse, corresponding to variation in soil moisture. Some typical associates are *Adenocaulon bicolor* Hook., *Agrostis pallens* Trin., *A. scabra* Willd., *Aquilegia formosa* Fisch. ex DC., *Carex amplifolia* Boott, *C. bolanderi* Olney, *C. feta* L.H. Bailey, *C. hirtissima* W. Boott, *C. laeviculmis* Meinsh., *C. lemmonii* W. Boott, *C. pachystachya* Cham. ex Steud., *C. stipata* Muhl. ex Willd., *Circaea alpina* L., *Equisetum arvense* L., *E. hyemale* L., *Fragaria vesca* L., *Galium bolanderi* A. Gray, *Geum macrophyllum* Willd., *Hieracium albiflorum* Hook., *Juncus effusus* L. subsp. *pacificus* (Fernald & Wiegand) Piper & Beattie, *J. exiguus* (Fernald & Wiegand) Lint ex Snogerup & Zika, *J. laccatus* Zika, *J. triformis* Engelm., *Linnaea borealis* L., *Luzula comosa* E. Mey. var. *laxa* Buchenau, *L. parviflora* (Ehrh.) Desv., *Mimulus moschatus* Douglas ex Lindl., *Pteridium aquilinum* (L.) Kuhn, *Rhynchospora capitellata* (Michx.) Vahl, and *Scirpus microcarpus* J. Presl & C. Presl.

Etymology.—*Carex cyrtostachya*, or arching sedge, is named for its curving or pendulous (*cyрто-*) pistillate spikes (*-stachya*).

Distribution.—The range of *Carex cyrtostachya* is limited to the northern Sierra Nevada foothills and northern high Sierra Nevada geographic subdivisions (Baldwin et al. 2012), from El Dorado County north to Yuba and Butte counties, California (Fig. 5). Populations of *C. cyrtostachya* are discontinuous within its range on the western slopes of the Sierra Nevada, with one cluster of populations in southeastern Butte County and adjacent Yuba County, and the other in El Dorado County. Only 13 populations have been documented, most of them quite small, within an area of 120 × 30 km. No populations have been found in the intervening Placer, Nevada, or Sierra counties. Arching sedge is thus a narrow endemic, restricted to just three counties in California. There are 12 other endemic *Carex* species in California (Mastrogiuseppe 1993, Zika 2012, Zika et al. 2012), as well as additional endemic members of the Cyperaceae, such as the recently described *Eleocharis torticulmis* S.G. Sm., restricted to a small area in the northern high Sierra Nevada of Plumas County (Smith 2001).

Conservation.—Most *Carex cyrtostachya* populations are small, difficult to locate, and potentially threatened by logging and invasive *Rubus*. The species should receive some conservation attention. More inventory is needed and systematic census data are lacking, but based on our initial field surveys and observations, and the herbarium records, there may be fewer than 20 populations and 2000 plants in total. A few populations are on land managed by the US Forest Service, in the Plumas and El Dorado National Forests, but other locales are at low elevations on private land and susceptible to development or hydrological changes.

Additional specimens examined: **U.S.A. California. Butte Co.:** Bean Creek bridge on Bean Creek Road, 609 m, 29 Jun 1988, Ahart 6108 (CAS, CHSC); marshy meadow at upper reach of Brush Creek, 953 m, 2 Jul 1988, Janeway 2955 (CHSC, WS); small lake 1 mi S of Brush Creek, 997 m, 14 May 1990, Oswald 4208 (CHSC, WS); 0.25 miles W of Lost Creek Reservoir, 1036 m, 6 Jul 1993, Ahart 7052 (CHSC); 0.5 mi NW of Lost Creek Reservoir, 1021 m, 19 Jul 1998, Ahart 8052 (BRU, CHSC, DAV, HSC, JEPS, WTU); same site, 6 Jul 2011, Zika 25535 (CAS, CHSC, OSC, WTU); W side of Pinkard Creek, 1.2 road mi N of Lost Creek Reservoir dam, 6 Aug 2006, Janeway 8826 (CHSC, WTU); same site, 6 Jul 2011, Zika 25536 (CAS, CHSC, GH, JEPS, MICH, MO, OSC, UCR, WTU); upper W branch of Know-Nothing Creek, Lumpkin Ridge Road, 1219 m, 7 Jul 2000, Ahart 8558 (CAS, CDA, CHSC, JEPS, NY, RM, RSA, SD, WTU); same site, 28 Jul 2002, Janeway 7689 & Castro (JEPS, CHSC); same site, 3 Aug 2006, Waterway 2006.160 & Janeway, Lechowicz (MTMG); same site, 5 Aug 2011, Zika 25713 & Wilson, Ahart, Janeway (CAS, CHSC, JEPS, OSC, RSA, WTU); large bare granite opening 1.1 km NE of Little Bald Rock, 1009 m, 22 May 2007, Ahart 13912 (CHSC, JEPS, WTU); same site, 10 Jul 2007, Janeway 9112 & Ahart, Hanson (WTU); same site, 5 Aug 2011, Zika 25712 & Wilson, Ahart, Janeway (CHSC, OSC, WTU). **El Dorado Co.:** bog along Slab Creek, 0.25 mi W of Kings Meadow, E of Pino Grande, 1340 m, 11 Jul 1968, Stebbins 6757 (CAS); Kings Meadow, near headwaters of Slab Creek, 1359 m, 23 Aug 2006, Janeway 8860 (CHSC, WTU); upper Gaddis Creek near Mainline Road, Blodgett Forest, Georgetown Divide, 1310 m, 17 Jul 1973, Rubtzoff 7088 & Howell (CAS); same site, 24 Aug 2006, Janeway 8868 (CHSC, WTU); S Fork Bacon Canyon near Bacchi Corral Road, Blodgett Forest, 1295 m, 19 Jul 1973, Rubtzoff 7182 & Howell (CAS); same site, 19 Jul 1973, Rubtzoff 7187 & Howell (CAS); Rock Canyon Creek, 200 m upstream of confluence with Traverse Creek, Traverse Creek Special Interest Area, El Dorado National Forest, 680 m, 8 Jul 2007, Janeway 9080 (CHSC, WTU); same site, 17 May 2012, Zika 25877 & Janeway (CHSC, OSC, WTU). **Yuba Co.:** Hampshire Creek Meadow, 1.5 air km E of Clipper Mills, Plumas National Forest, 1026 m, 13 Jul 2007, Janeway 9116 & Ahart, Hanson (WTU); same site, 7 Aug 2007, Ahart 14419 (CHSC); same site, 5 Aug 2011, Zika 25718 & Wilson, Ahart, Janeway (CHSC, JEPS, OSC, WTU).

We examined the available types of *Carex mendocinensis*, *C. gynodynamis* Olney, and their synonyms (*C. cinamomea* Olney, *C. debiliformis* Mack. and *C. blankinshipii* Fernald), as well as 300 herbarium specimens, to establish the differences between them and *C. cyrtostachya*. We also wanted to ensure that none of the names in synonymy might apply to *C. cyrtostachya*. The descriptions of several of these taxa clearly stated or implied which gathering was the type, but failed to specify which duplicate was the holotype. In addition, part of the type series of *C. mendocinensis* was a hybrid with *C. gynodynamis*. Consequently, several notes on typification and some lectotypifications were needed. The types of *C. gynodynamis* and *C. mendocinensis* were numbered consecutively by Bolander and appear to be from a large mixed population that included hybrids. Like Howell (1951) we believe it is reasonable to assume they were all collected on the same date at the same place. One of the duplicates, at DS, has the precise date of collection, 11 May 1866. William Boott described *C. mendocinensis*; his original material at Harvard is the lectotype selected below, and the specimen is consistent with his protologue. Howell (1951) noted the material in Boott's herbarium was not a mixed collection (Bolander 4701 GH, ex herb. W. Boott), and we agree. However, some of the isotypes we annotated from BH, BM, BRU, and US were mixed collections of *C. mendocinensis* with the similar-looking sterile hybrid *C. gynodynamis* × *C. men-*

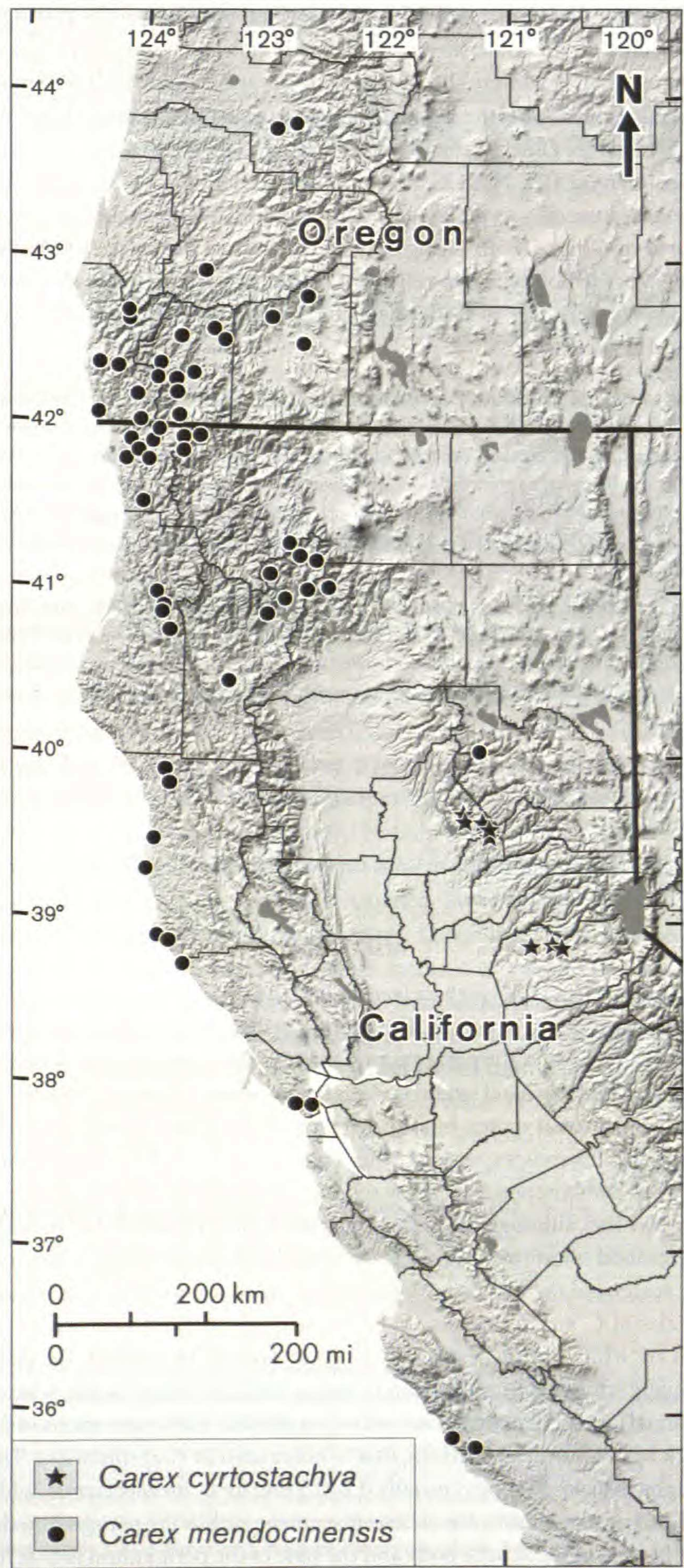


FIG. 5. Distribution of *Carex cyrtostachya* and *C. mendocinensis*, based on verified herbarium vouchers.

docinensis. The hybrid plants fail to exert or dehisce their anthers and thus can be distinguished from the type material of *C. mendocinensis* on the same sheets, which, although often immature, has dehiscent anthers or exerted filaments where the anthers were shed. Howell (1951) and Waterway (1988) reported isotypes of Bolander 4701 at NY were also a mix with the hybrid, but we were unable to examine them. We also inspected the available types of *C. cinnamomea* Olney, a synonym of *C. mendocinensis*. Howell (1951) discussed the taxonomy and cited type specimens at GH, NY, UC, and US, but did not select a lectotype. We designate Olney's original material at Brown University as the lectotype (Bolander 6477 BRU, ex herb. S. T. Olney). *Carex gynodynamis* was also described by Olney (1868), citing only one gathering, Bolander 4700, but not specifying which of the many duplicates was the holotype. Howell (1951) effectively lectotypified the name by citing Bolander 4700 (BRU) as the type. We were able to study the lectotype and nine isotypes of *C. gynodynamis*; none appeared to include hybrid elements.

Carex mendocinensis Olney ex W. Boott, Bot. California 2:249. 1880. TYPE: U.S.A. CALIFORNIA. Mendocino Co.: swamps near Mendocino City, spring [11 May] 1866, H. N. Bolander 4701 (LECTOTYPE, here designated: GH (bar code 342878, ex herb. W. Boott, right side of sheet)!; ISOTYPES: BH (bar code 53976, inflorescence on far left, and inflorescence 4th from right margin, the rosettes and remaining 6 inflorescences are hybrids, *C. gynodynamis* × *C. mendocinensis*!; BH (bar code 53977)!, BM (two center plants, hybrids on extreme left and right)!, BRU (left side of sheet, hybrid on right)!, CAS (fragment)!, DS!, GH (bar code 342876, left side of sheet)!, K(2)!, NY (2), POM!, UC(2), US29453 (bar code 26804, left and right side of sheet, hybrid in middle)!, US319264 (bar code 1105537, right side of sheet, hybrid on left side)!).

Carex cinnamomea Olney, Proc. Amer. Acad. Arts 7: 396. 1868. Not *Carex cinnamomea* Boott, Proc. Linn. Soc. Lond. 1:257. 1846. *Carex debiliformis* Mack., Bull. Torrey Bot. Club 37:244. 1910. TYPE: U.S.A. CALIFORNIA [incorrectly cited as Humboldt Co. in the protologue, but in modern Mendocino Co., which is how Bolander labeled isotypes at GH, K, and US; extant and common in 2012]: In swamp on Red Mountain, [11 Apr–24 May] 1866, Bolander 6477 (LECTOTYPE, here designated: BRU (bar code 8, ex herb. S.T. Olney)!; ISOTYPES: BH(3)!, BM!, BRU (bar code 7)!, CAS(fragment)!, CU, DS, GH(2)!, K!, MO, NY, UC, US(2)!).

Carex gynodynamis Olney, Proc. Amer. Acad. Arts 7:394. 1868. TYPE: U.S.A. CALIFORNIA [Mendocino Co.]: swamps near Mendocino City, [11 May] 1866, Bolander 4700 (LECTOTYPE, designated by Howell 1951, p. 160: BRU!; ISOTYPES: BH(3)!, CAS!, CU, DS!, GH(2)!, MO(2), NY(2)!, PAC, POM, UC(3), US).

Carex blankinshipii Fernald, Erythraea 7:121. 1899. TYPE: U.S.A. CALIFORNIA. Humboldt Co.: Hydesville, 19 Jun 1893, Blankinship s.n. (HOLOTYPE: GH!, ISOTYPE: BH(fragment)!).

DISCUSSION

Carex cyrtostachya is closely related to *C. mendocinensis*, and the two are compared in Table 1. Most specimens are easily segregated by inflorescence structure. The lateral pistillate spikes of *Carex cyrtostachya* arch or droop, or dangle on flexuous peduncles, and the perigynia are more widely spaced (Figs. 1, 2A). *Carex mendocinensis* usually displays erect or ascending distal lateral spikes that are densely fruited (Fig. 2B). Occasional plants of *C. mendocinensis* show lax proximal spikes, but the distal pistillate spikes remain essentially erect. In addition to the obvious inflorescence differences, several other characters are useful in identification. Although none are absolutely exclusive, in combination they allow reliable identification. The staminate scales of most plants of *C. mendocinensis* are awnless, although the lower scales rarely have an awn 0.3–0.5 mm (e.g., Peck 8792 (GH), Curry Co., Oregon). Proximal staminate scales of *C. cyrtostachya* have prominent awns, often 1–5 mm long. In addition, the pistillate scales and their awns are longer in *C. cyrtostachya*, with some overlap in measurements. The perigynia and scales of *C. mendocinensis* are green, strongly marked with red or purple or red-brown; rarely the scale bodies are white-hyaline, especially when immature. In contrast, the pistillate scale bodies of *C. cyrtostachya* are usually white-hyaline, only rarely with a faint red-brown wash, whereas the perigynia are green with only occasional faint or inconspicuous red or purple dots. Some specimens of *C. mendocinensis* have perigynia entirely dark red or purple, something that is never seen in *C. cyrtostachya*. The perigynium shape and size is similar, but the discolored stipe is usually 0.1–0.3 mm for *C. mendocinensis*, while it is usually longer in *C. cyrtostachya*, 0.3–0.5 mm. Similarly, the achene placement within the perigynium differs slightly, so that the distance between the base of the achene body and the base of the perigynium is 0–0.7(–0.9) mm in *C. mendocinensis* and (0.5–)0.7–1.2 mm in *C. cyrtostachya* (Fig. 3). The upper culm, inflorescence rachis, or peduncles of *C. mendocinensis* are often scabrous, while they tend to be smooth or faintly scabrous in *C. cyrtostachya*.

TABLE 1. Comparison of *Carex mendocinensis* and *C. cyrtostachya*. Based on measurements from 30 representative specimens of each species.

| Character | <i>C. mendocinensis</i> | <i>C. cyrtostachya</i> |
|--|---|--|
| Foliage | glabrous, occasionally hairy near blade base | glabrous, rarely hairy near blade base |
| Ligules | apex acuminate, acute, rounded or notched, 1.6–6.5(–11) mm | apex acute to acuminate, 1.1–12.6 mm |
| Anther length | 1.8–3.4 mm | 1.8–3 mm |
| Distance between perigynia in mid-spike, distal spikes | usually densely packed, 0.3–0.6(–1.2) mm | usually well separated, 0.7–3.5(–6) mm |
| Aspect of distal spikes | usually erect or ascending | arching or drooping |
| Pistillate scale color | midvein green, body usually streaked or marked with red-brown to purple-brown, rarely white hyaline | midvein green, body white hyaline or faintly marked with red-brown |
| Pistillate scale length including awn | 1.7–3.2(–3.7) mm | (2.2–)3–4.8(–6.8) mm |
| Pistillate scale awn length | 0–0.3(–2) mm | (0–)0.5–1.5(–3.1) mm |
| Proximal staminate scale awn length | 0(–0.5) mm | (0.3–)0.5–5 mm |
| Perigynium stipe | 0.1–0.3(–0.5) mm | 0.3–0.6 mm |
| Perigynium color | green, aging brown, often with red to purple splotches or dots; occasionally entirely dark purple | green, aging brown; occasionally with red or purple dots; never entirely dark purple |
| Substrate preference | mostly on serpentine, saturated soil | mostly off serpentine, mesic to saturated soil |

Carex mendocinensis hybridizes with *C. gynodynamis* (Howell 1951; Waterway 1990b). We found no potential hybrids or intermediate morphologies between *C. mendocinensis* and *C. cyrtostachya*. The two are not known to grow together; they are disjunct by 200 km (Fig. 5), with a single exception. An occurrence of *C. mendocinensis* in the northern high Sierra Nevada of Plumas County was discovered by Lowell Ahart in 2000 (Ahart 8381 CHSC), where the two species are separated by only 40 km.

Carex cyrtostachya, with its long, loosely-fruiting arching to drooping pistillate spikes, closely resembles *C. arctata* Boott and *C. debilis* Michx. in eastern North America. There is a gap of more than 2000 km in their ranges, and they differ in foliar and perigynium characters. *Carex arctata* has broader and more evergreen basal leaves, and perigynia with shorter stipes and longer beaks. *Carex debilis* has, among other differences, longer perigynia with less distinct beaks (Waterway 2002). In tropical America *C. flexirostris* Reznicek and *C. perlonga* Fernald are superficially similar to *C. cyrtostachya*, but the latter is separable from these by its uniformly pistillate lateral spikes, straight perigynium beak, and awned staminate scales (Reznicek 1986).

For now we follow the taxonomy of Reznicek (1986) and Waterway (2002) in defining *Carex* sect. *Hymenochlaenae*, although molecular work in progress suggests the sectional alliances may change in the future (Waterway & Starr 2007). Six similar species from the section are contrasted in the key below. Five are native in Oregon and California, and one (*C. sylvatica* Huds.) is adventive in the Pacific Northwest.

KEY TO CAREX CYRTOSTACHYA AND SIMILAR SPECIES IN WESTERN NORTH AMERICA

- 1. Leaf sheaths at culm (stem) bases light brown to dark brown; terminal spike staminate (rarely staminate/pistillate/staminate)
 - 2. Distal lateral spikes often androgynous or staminate; perigynia pubescent, with 2 strong ribs and 12–20 veins; lateral spikes 6–15, sometimes more than one spike per node; endemic to southern California _____ **C. obispoensis** Stacey
 - 2. Distal lateral spikes pistillate; perigynia glabrous, with 2 strong ribs and no conspicuous veins; lateral spikes 3–5, always solitary at nodes; naturalized in western British Columbia and western Washington _____ **C. sylvatica** Hudson
- 1. Leaf sheaths at culm bases dark purple; terminal spike staminate or gynecandrous (rarely androgynous)
 - 3. Leaf blades and sheaths glabrous or leaf base and sheath apex sparsely hairy; basal or rosette leaves 2–6 mm wide, usually less than 5 mm wide; perigynia usually glabrous, rarely sparsely appressed-hairy near beak in *C. mendocinensis*.
 - 4. Distal lateral spikes loose and arching or drooping; proximal staminate scales with awns 0.5–5 mm long; pistillate scales, including awns, usually 3–4(–6.8) mm long, the awns usually 0.5–1.5(–3.1) mm long _____ **C. cyrtostachya** Janeway & Zika

4. Distal lateral spikes dense and erect or ascending; proximal staminate scales awnless (rarely with short awn 0.3–0.5 mm); pistillate scales, including awns, usually 1.7–3.2(–3.7) mm long, the awns usually 0–0.3(–2) mm long _____ **C. mendocinensis** Olney ex W. Boott
3. Leaf blades and sometimes sheaths densely hairy; basal or rosette leaves occasionally 7–12 mm wide; perigynia usually conspicuously long-spreading-hairy, rarely glabrous in *C. hirtissima*.
5. Pistillate scales red-brown or purplish with a green midrib; perigynia splotched with purple; coast ranges of Oregon and California _____ **C. gynodynamis** Olney
5. Pistillate scales green, white, or pale red-brown with a green midrib; perigynia sometimes red-dotted but not splotched with purple; coast ranges and west slope of Sierra Nevada in California _____ **C. hirtissima** W. Boott

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